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SPRAYING EQUIPMENT

The present invention relates to a novel piece of equipment for spraying a liquid additive composition onto a solid product, for example a foodstuff. It relates 5 more particularly to apparatus which allows homogeneous spraying of very small amounts of a liquid constituent onto relatively large amounts of solid product.

The term "solid product" as used herein is intended to embrace a product in the form of pellets, or 10 in the form of a crumble, or in the form of a powder which can be used to form a mash feed.

A preferred application of the present invention relates to apparatus for spraying liquid food additives which are to be present in the foodstuff in small weight 15 amounts and which consist essentially of enzymes and/or vitamins and/or carotenoids. The said additives are often added in very small quantities of the order of a few tens or hundreds of grams per ton of foodstuffs.

In the prior art there are various examples of 20 mixing additives to a major constituent, for example in US-A-4108335, US-A-5516625 and DE-A-4413249.

Where the major constituent receiving the additive minor constituent is in solid form it has been proposed previously to dilute the additive in a carrier 25 liquid, for example as proposed in WO-A-97/16964. Another example of dilution of the additive is disclosed as one optional possibility in Patent EP 789291, where there is described apparatus comprising:

- one or more thermostatted containers which 30 contain the enzyme which may be in pre-diluted form;
- a system for extracting the liquid enzyme from its container;
- a flow regulation valve;
- a flow meter with high sensitivity;
- 35 - an injection system which has an adjustable angle of atomization; and
- a microprocessor-controlled electronic system

-2-

for regulating the dose of the liquid enzyme.

Although this spraying system, which is very efficient and has been used commercially for many years, allowed the introduction of a liquid food additive which might be in pre-diluted form, it was not constructed with a view to allowing continuous variation of dilution. With use it appeared that this system was not perfectly adapted for enzymes which had to be introduced at different concentrations, or for the introduction of several different constituents which are mutually incompatible, whether from a physical or chemical point of view.

Thus, the introduction of additives such as enzymes in aqueous solution could not be carried out with the concomitant introduction of additives in lipid form 15 such as the vitamins A or E, or proteases could not be introduced with protein enzymes.

In the prior system, the dilution of the enzyme was determined in advance and the quantity of diluted enzyme was adjusted by the microprocessor-controlled flow meter to be related to the amount of foodstuff which passed on a conveyor belt. With this system, there was a constant adaption of the flow rate of the spraying flow to the amount of dry foodstuffs transported by the conveyor belt.

25 However, it has now been found, unexpectedly,
that it is easier and more advantageous to adapt the
dilution of the additive in the diluent (water) both to
the amount of dry foodstuffs transported by a conveyor
belt and to the flow of the additive so as to keep the
30 total spraying flow constant for a constant flow rate of
dry foodstuffs.

Thus, the present invention relates to a device for spraying an additive diluted with a diluent therefor, consisting of:

- a diluent container;
- a further container for a said additive;
- at least one mixer;
- conduits communicating said diluent container and

-3-

additive container with said mixer for allowing the dilution of the additive by the diluent from said diluent container;

- spraying means connected to receive the output from said at least one mixer with a constant flow rate and to spray it at a spray zone; and

- means for transporting a solid product to said spray zone to receive the additive;

- wherein in said conduits there is a respective regulation valve per liquid associated with the first mentioned and further containers; there are dilution control means for controlling said regulation valves to control the rates of flow of the diluent and additive to said mixer, said dilution control means being responsive to the flow of solid product being conveyed by said transporting means to control the rate of flow of the additive in proportion to the flow of solid product, and being effective to vary the flow of diluent in response to the desired total flow rate of liquid to said spraying means to maintain a constant total flow rate;

- characterised in that the spray nozzle is aimed towards a conveyor for a solid product to be sprayed, and in that the control means are in the form of a microprocessor responsive to the weight of solid product present on the conveyor.

The present invention preferably employs static mixers.

The transporting means may be a conveyor and the regulation valves may be managed by a microprocessor which, according to the weight of solid product present on the conveyor where the additive/ diluent mixture is sprayed, modulates the proportional flow rate of the different additives and diluent in such a way as to maintain a spraying flow rate which is constant and proportional to the weight of solid product.

If, according to Figure 1, the flow is followed starting from the water container (1), the liquid is pumped by the pump (3) as far as the flow meter (4), then is introduced into a regulation valve (5) before being introduced into the mixer (6).

If the flow is followed starting from the first additive container (2), the liquid is pumped by the pump (3) as far as the flow meter (4), then is introduced into a regulation valve (5) before being introduced into the mixer (6). This is the case for each further additive.

The mixture of water and several different additives is sprayed by an injector (7) with a constant flow rate assisted by a flow of air (8) on a flow of granules. Although the granules may be travelling on a conveyor, e.g. a horizontal belt conveyor it is preferable for them to be sprayed while dropping vertically from a pelleting chiller. Any other transport means for the solid product can be used.

When several of the additives cannot be mixed together in the aqueous flow, several spraying systems may be individually adapted to the throughput of the apparatus, so as to give a variable application of each additive to the solid product, while maintaining optimum flow through the spray nozzle. It is evident that, even if the additives are mutually compatible, it may be advantageous to adapt several spraying nozzles to the outlet of the apparatus.

The advantages of the present device are as follows:

- homogeneous distribution of the liquid additive(s) onto the foodstuff
- regulation of the flow rate of one of the additives without necessarily disturbing the functioning of the atomization nozzle
- conformity with the statutory demands on premixed additives
- mixing of mutually unstable products.

It has been found that with the system of the present invention it is possible to achieve a wide variation in the flow rates of the various liquids, and a precisely controlled application rate of the at least one additive to the solid product. For example, the

application rate of any one of the additives can be in the range of from 1 litre to 15 litres per hour, and as an example it is possible for two separate additives to be introduced to the diluent water flow, one at the rate of 5 1 litre per hour and the other at a flow rate of 15 litres per hour.

In order to maintain optimum flow conditions at the spray nozzle, the flow of water will be selected so as to provide the required flow rate which may be in the 10 range of from 20 - 100 litres per hour per spray nozzle.

Using such values, it is possible to achieve a homogeneous application of from 0.5 to 1 litre of an additive per tonne of solid foodstuff granules passing through the apparatus.

15 Although throughout the present application there is reference to a solid product to which the additive/diluent mixture is applied, this is intended to denote that the product is not flowable, and in the preferred use of the apparatus the solid product will be a 20 dry product, preferably in granular form.